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RECENT PUBLICATIONS.

REVIEWS.

Vital Statistics, An Introduction to the Science of Demography. By G. C. WHIPPLE, Professor of Sanitary Engineering in Harvard University. New York, Wiley, 1919. xii + 517 pages. 12mo. Price \$4.00.

This interesting and instructive book was not written primarily for mathematicians, but it stresses the need of mathematics and an intelligent, discriminating use of mathematics. The preface reads: "This book is written for students who are preparing themselves to be public-health officials and for public-health officials who are willing to be students . . . it emphasizes the need of using vital statistics with truth, with imagination and with power."

Printed in very attractive form, with numerous diagrams, tables, and illustrative matter (with 529 pages, but only $\frac{3}{4}$ inch in thickness), the book should fulfill its mission; it should also make an appeal to the general public; and, indeed, to mathematicians who are interested in the social sciences.

The mathematics involved runs from arithmetic up to the theory of probability and to correlation. As an application of Bernoulli's Theorem in probability, an epidemic of typhoid is postulated for a city where milk is supplied by two dealers—page 399. If the epidemic is due to the water supply of the city, each dealer should have among his customers about the same percentage of typhoid cases—other circumstances being the same. The problem is to determine how many cases above his proportionate number a milk dealer must have in order that suspicion may properly fall upon the milk he sells.

The author condenses in 60 pages some of the elements of probability, correlation, and life insurance—trying to impart some information to students not well trained in mathematics. In this condensation, certain infelicities have made their appearance. Frequency and probability are not adequately distinguished (p. 398). The so-called "probable error" is confused with the most probable error (pp. 390, 391). The name "curve of error" is applied to a cumulative curve of error (pp. 386, 387), and the latter is improperly described at the foot of p. 390. The "expectation of life" is confused with the "most probable lifetime" on p. 422, but on pp. 427, 428, the proper distinction is made. The Combined Experience Mortality Table, mentioned on p. 431, was based upon the data of British companies instead of American companies, and the date of the Northampton Table, given on p. 431 as 1762 is given by Henry Moir as 1783. It is not clear what distinction the author had in mind on p. 410 between Pearson's coefficient of correlation and Galton's. That the graphical method of getting the coefficient of correlation on pp. 412, 413, is defective, can be seen by supposing that each wheat-price were raised ten shillings—this would not alter the coefficient of correlation, but the computation on p. 413 would be altered. On p. 411,

the figure 0.54 is said to represent "low correlation." In a probability table on p. 392, the figure 0.5872 appears instead of 0.5817, and on p. 393 the figures 0.58 and 0.77 appear instead of 0.57 and 0.78, respectively. In the solution of the problem on p. 399, relating to the milk dealers and mentioned above, hardly enough allowance has been made for natural dispersion.

No attempt was made by the reviewer to check the many tables and statistical data in the book, but in glancing at the population table on p. 158, it was noticed that the population of Cleveland, Ohio had been used also for Cincinnati, Ohio—evidently a typographical error.

Vital Statistics is arranged with a set of exercises and questions at the end of each chapter, so that it may be used as a text-book. Such a stimulus to thought can not be too highly recommended, even for books not intended primarily as texts. In these questions, numerous references to the literature of the subject are given.

There is also a short bibliography in Appendix I. Here misprints appear in the names of Willford I. King and Harald Westergaard. Another book of Westergaard's, also published by Fischer, is *Die Grundzüge der Theorie der Statistik*, a book of some interest to mathematicians. E. Davenport's *Principles of Breeding*, with Appendix by H. L. Rietz (Ginn & Co.) may be added to the list; also, Merriman's *Text-Book on the Method of Least Squares* (Wiley). A more extended bibliography, for advanced work, would have included the names of Czuber, Poincaré, Borel, Bachelier, Bruns, Blaschke, Carvallo, Markoff, Montessus de Ballore, and many of the older authors. Among periodicals, *Biometrika* might well be mentioned. Appendices II and III give model state laws for reports of sickness, births and deaths, and standard certificates of birth and death. Appendix IV is a 5-place table of logarithms. Finally, there is an Index.

The following is a condensation of the "Contents" as listed on pp. vii-xii. For mathematicians, Chapters II, XII, XIII, XIV, will be of special interest,—as showing how mathematics is applied.

Contents. Chapter I. Demography: History of statistics—Vital Statistics; The statistical method. II. Statistical Arithmetic: Collection of data; Tabulation; Precision and accuracy; Logarithms; The slide-rule; Classification and generalization; Averages; The moving average; Mechanical devices. III. Statistical Graphics: Types of diagrams; Graphical deceptions; Summation diagrams; Polar coordinates; Double coordinate paper; Logarithmic cross-section paper. IV. Enumeration and Registration: United States census; Credibility of census returns; Births, deaths, marriages, sickness. V. Population: Estimation of population; Arithmetical increase—Geometrical increase; Decreasing rate of growth—Difference between estimate and fact; Population of U. S. cities (a table); Classification of population; Errors due to use of round numbers; Other sources of error; Standards of age distribution. VI. Death-rates, Birth-rates, Fecundity. Marriage-rates; Divorce-rates; Marriage-rates, birth-rates and death-rates in Sweden; Birth-rates, death-rates, marriage-rates and divorce-rates in Massachusetts. VII. Specific Death-Rates: Age, sex, marital condition, nationality; Chronological changes; Particular diseases. VIII. Causes of Death: Nosology; International list of causes of death; Present-day classification. IX. Analysis of Death-Rates: Two methods. X. Statistics of Particular Diseases: Tuberculosis; Diphtheria; Typhoid fever; Cancer. XI. Studies of Deaths by Age Periods: Infant mortality, its chronological reduction; Pre-natal deaths; Expectation of life at different ages; Causes of infant deaths; Maternal mortality; Diseases of early childhood; Proportionate mortality; Median age of persons living. XII. Probability: Natural frequency; Coin tossing; Chance; Binomial theorem; Chance and natural phenomena; Frequency curves, including skew curves;

Frequency curves shown by summation diagrams—Deviation from the mean; Standard deviation; Coefficient of variation; Computation of coefficient from grouped data; Probable error; Doubtful observations; The probability scale; Probability cross-section paper. Another use of probability; The frequency curve as a conception. XIII. Correlation: Correlation and causality; Laws of causation; Methods of correlation; Galton's coefficient of correlation; Example of low correlation—Correlation shown graphically; Correlation table; Use of mathematical formulæ; Secondary correlation; The lag—Coefficient of correlation and the lag; Other secondary correlations; The epidemiologist's use of correlation. XIV. Life Tables: Probability of living a year; Mortality tables; Most probable life-time; "Vie probable"; Expectation of life; Comparison of the three methods; Life-tables based on living populations; Mathematical formulæ; Early history of life-tables; Recent life tables; United States Life Tables: 1910; A few comparisons. XV. A Commencement Chapter: Military statistics; Industrial diseases; Accidents; Infantile paralysis; Sanitary index.

EDWARD L. DODD.

The Sumner Line, or Line of Position as an Aid to Navigation. By GEORGE C. COMSTOCK. New York, Wiley. 6 + 70 pages. 12 mo. Price \$1.25.

This is one of a dozen or more of little books on navigation that have appeared within the past two years as a result of the increased activity of the Navy and the Merchant Marine. Many teachers of the subject have apparently felt that the standard American text book on navigation, "The American Practical Navigator," originally by Nathaniel Bowditch, is, in some respects, open to criticism, and they have tried to improve upon the explanations and methods used in various parts of the book.

Professor Comstock has confined his book to problems connected with the determination of the Line of Position, the method of locating a ship at sea, which has been adopted by the U. S. Navy.

Presuming familiarity on the part of the reader with the elements of navigation, the Nautical Almanac, and such instruments as the sextant, compass, chronometer, and log, the author begins with an explanation of the sub-solar point, *i. e.*, the point on the earth directly under the sun (or any other heavenly body). He then takes up the Circle of Equal Altitude, and the location, by the methods of St. Hilaire and de Aquino, of the Line of Position or that part of the Circle of Equal Altitude which is in the vicinity of the observer's ship.

The theory of the spherical traverse tables is fully explained, and their use is illustrated not only in finding the azimuth and the "calculated" altitude, but also in solving such problems as finding the amplitude, the time when a star will cross the Prime Vertical, and the identification of an unknown star.

One of the novel features of the book is the method of finding the coördinates of the intersection of two Lines of Position. This is commonly done at sea by plotting the lines on a chart. In Bowditch and in other epitomes, methods, based on the solution of right triangles, are given for computing the coördinates of intersection when a chart is not available. Professor Comstock has resorted to analytical geometry and has expressed his results in terms which can be handled by the use of plane traverse tables. This is of interest from a mathematical point of view, but probably will not become popular with practical navigators because of the many possibilities of mistakes, especially in algebraic signs.

Another feature of the book is the revival of horizon observations. Methods of determining the longitude from sunrise and sunset observations used to be given in the old epitomes, but, on account of the uncertainty of refraction near the horizon, those methods were omitted years ago. Professor Comstock has prepared a special table of Horizon Corrections for different temperatures and pressures, which, under normal conditions at sea, ought to enable the navigator to get fairly good results from horizon sights.

Throughout the book Forms are used for the systematic arrangement of the computations, and, to accompany the book, pads of Blank Forms have been prepared for working the St. Hilaire or de Aquino methods of finding the Line of Position. On each blank is a skeleton chart for plotting the lines.

F. SLOCUM.